Regional San South Sacramento County Agricultural and Habitat Lands Recycled Water, Groundwater Storage, and Conjunctive Use Program

- Uncertainty Analysis -

Benefit Calculation, Monetization, and Resiliency Tab A.12

10.1 Uncertainty Associated with Climate Change

Climate change presents challenges as it calls for making decisions on the basis of uncertain or incomplete information. Adaptation to climate change is an important aspect of the Program in the face of uncertainty. Regional San will continue to use a wide range of information sources and data to adapt to climate change and consider improved understanding of climate change effects to sustain the benefits claimed by the Program.

Climate varies naturally and is exacerbated by human influence. Future conditions can differ from those considered based on current understanding of future projections. Some climate uncertainties are due to an incomplete understanding of future climate while others relate to the inherent variability in the climate and environmental systems. Climate change variability is one of the main sources of uncertainty in estimating future climate change and is often addressed by running multiple simulations of climate models. Models are useful tools used to increase the confidence placed in the projected changes that are likely to occur with climate change. However, as with any data and information, particularly when it is derived from models, there are associated uncertainties. The modeling performed for the 2030 and 2070 climate conditions used hydrologic data modified with climate change projections or perturbations following the methodology and data available from the CWC based on grid cell data from 20 downscaled global climate model projections. One aspect of the modeling uncertainty arises from downscaling from global climate models to regional models in order to provide climate change information at a scale that is more representative for the specifics of the region.

The modeling performed covered a wide range of hydrologic conditions with the inclusion of an extended drought period. The 42 years of hydrologic conditions were simulated twice with the SacIWRM model, demonstrating that the Program will perform well across these wide ranges and will achieve substantial benefits. The Program will recharge up to 50,000 AFY of recycled water to agricultural lands, but plans to extract only 30 percent of recharged water, leaving the remaining 70 percent in the basin for public benefits. The recycled water supply itself will be drought and climate change resilient because it comprises only 38% of annual discharge volume by Regional San (based on 120 mgd dry weather flow), so even if flows to the Regional Plant are reduced by double digit percentages, there will be excess recycled water available in all months of all year types. At Regional San's permitted flow of 181 mgd, the 50,000 AFY constitutes 25% of the annual discharge volume. In addition, the Program will only extract when the banked water is available and the extraction will cease when the banked water reaches zero. Under more extreme conditions than those represented in the 2070 climate change, the recharged water left in the basin, and resulting benefits will become more important than ever to mitigate, or even reverse the negative effects of climate change on groundwater resources, streamflows, and ecosystems. Without the Program in place, under more extreme dry conditions, groundwater levels are anticipated to decline with increased groundwater pumping to meet demand.

Streamflows are anticipated to decline and continue to degrade riparian and wetland ecosystems. The modeling analysis demonstrates that the Program is anticipated to have substantial benefits to groundwater, streamflows, and ecosystem with more variable and more extreme hydrologic conditions than those modeled. See Benefit Calculation, Monetization, and Resiliency tab, A.1 Project conditions, RMC SacIWRM Technical Memo for more information on the model.

Project facilities allow for some flexibility in conveyance and pumping capacity to accommodate changes to Program operations (RMC, 2015b). Water supply for recycled water deliveries is dependent on the water rights process through a Petition for Change, rather than on a variable surface or groundwater source. The availability of 50,000 AFY of recycled water is expected regardless of climate conditions, but the timing of availability of that water could be impacted by climate conditions in any given water year, particularly conditions that are more extreme than modeled. Climate- and hydrology- related impacts to project operations are expected to occur two out of 84 years under 2030 climate conditions and eight out of 84 years under 2070 climate conditions (RMC, 2017). More extreme climate conditions would likely increase that frequency, depending on the severity of change (see HYD-4 explanation in Future Project and Water Management Activities section below for details on seasonal impacts associated with hydrologic conditions). Project operations can be adjusted for changes in the timing of recycled water availability, but some benefits (particularly water banking-related because the ecosystem-related benefits will be based primarily on restored groundwater elevations which are paramount) may be impacted by major and regular changes to the timing of recycled water deliveries. More water could be delivered at different times of the irrigating season (depending on irrigation demands and system conveyance capacities) or for wintertime recharge (depending on recharge and system conveyance capacities) to make up for reduced deliveries in other times of the year and reduce potential impacts to Program benefits caused by more extreme climate conditions.

10.2 Future Project and Water Management Actions

The proposed Program has a completed project- and program-level EIR, linked in **Feasibility & Implementation Risk Tab A.4**. Additional environmental documentation is still needed for project-level segments of the Program and groundwater banking, as described in the Environmental Feasibility section of the attachment in **Feasibility & Implementation Risk Tab A.1**. The completed EIR addresses cumulative impacts by impact type within the document. Of all the potentially significant cumulative impacts, only the Hydrology section impacts were found to have potentially significant impacts beyond construction. The Cumulative Impacts section below is an excerpt directly from the EIR document and discusses potential cumulative effects and how they are expected to be mitigated to less than significant. Mitigation measure HYD-4 is designed to reduce fishery impacts to cold water pool-related CVP or SWP Operations to less than significant. Modeling of benefits for the proposed Program includes implementation of HYD-4 recycled water delivery cut-backs during April and May for surface water modeling using CalSim II (CH2M, 2017). Groundwater modeling assumptions took an even more conservative approach of reducing recycled water deliveries by half for the entire irrigating season under critically dry year conditions (RMC, 2017). Details of HYD-4 implementation are still being discussed through the Petition for Change process, but benefits analysis for this grant application have already taken a conservative approach with respect to benefits changes caused by hydrologic conditions. The table following the Cumulative Impacts section is a list of cumulative projects considered in the EIR. See the full EIR document for additional details. https://www.regionalsan.com/post/south-county-ag-final-environmental-impact-report

Cumulative Impacts (Hydrology) – from EIR

The geographic scope for the Project's construction impacts is limited to the area in which the pump station and pipelines would be constructed. Other projects that would be constructed within the SRWTP and vicinity would all be required to comply with the Construction General Permit and to implement erosion control Best Management Practices (BMPs) during construction. Cumulative construction period water quality impacts are thus expected to be less than significant.

The geographic scope of potential operational impacts extends to the entire Sacramento River watershed. Evaluation of Project impacts used the SWP and CVP hydrology and system operations model, CalSim II, which was developed to simulate and evaluate changes to the complex water resources system of California under alternative conditions. The model simulates operations of the SWP, CVP, and other water districts/facilities in the Central Valley and approximates changes in storage reservoirs, river flows, and exports from the Delta that would result from a change in hydrologic conditions, water supply demands, facilities, requirements or operational policies. Modeling of Project impacts was done in the context of ongoing operations of other projects that divert water from the system, and thus considers cumulative effects. Because the CalSim II model would not have considered effects of other recycled water projects that might reduce discharges to the Sacramento River system, the evaluation of impacts has also considered reasonably foreseeable future discharge reductions as reflected in the State Water Resources Control Board web page that provides notices of Wastewater Change Petitions. The communities of Colusa, Woodland and Biggs are all proposing recycled water projects that would reduce discharges in the Sacramento River watershed. Total discharge reduction would be 1.86 cfs, which would be in addition to the maximum 108 cfs reduction associated with the proposed Project during peak periods at full implementation. The additional discharge reductions are minimal as compared to the flows in the Sacramento River at Freeport, where average flows range from about 19,000 to 14,000 cfs during the May to August time period when the demand for recycled water is highest and flows in the river are lowest.

Cumulative Effects of California WaterFix – from EIR

Sacramento River flows could also be affected if the California WaterFix is implemented. The California Department of Water Resources and Bureau of Reclamation are currently considering a project to provide more reliable delivery of water exports from the Delta through the State Water Project and the Central Valley Project. Originally developed as the Bay Delta Conservation Plan (BDCP), Alternative 4A, California WaterFix, has been identified as the preferred alternative, but environmental documentation for this option has not been completed, and a final decision regarding project implementation has not been made. Timing for implementation, if approved, is thus uncertain.

Evaluation of effects of the proposed Project depends on the timing of balanced and excess conditions, which dictates whether CVP and SWP reservoirs release stored water. These conditions would be expected to change under the California WaterFix, which could result in the following conditions:

- Export operations would be more dependent on excess flow conditions and conveyance of these excess flow through the North Delta Diversion intake
- Frequency of balanced conditions would likely increase in the Spring due to higher outflow requirements and upstream releases required to meet those requirements
- Ability to operationally respond and recover from a storage deficit (regardless of cause) would likely decrease with the increase in balanced conditions frequency

CalSim II modeling has shown that the Project's individual effects on CVP and SWP operations would be minimal, because reductions in discharge are almost entirely offset by increases in surface water flows due to higher groundwater conditions, which would benefit the Delta as a whole. The Cal WaterFix Alternative 4A could exacerbate potential Shasta storage impacts of the proposed Project. However, since the Project's impacts to storage can be fully mitigated, the Project would not contribute considerably to a cumulative impact to storage. Modeling has projected that CVP and SWP water service contractor deliveries would be reduced by 5,000 AFY at ultimate program implementation (a reduction of 4,000 AFY for Delta exports and a reduction of 1,000 AFY for deliveries to water users upstream of the discharge location on the Sacramento River). Reclamation staff have expressed concern about the effect of any Project related reductions in deliveries in light of the curtailment of deliveries to contractors during recent drought conditions. However, the Project's contribution to the cumulative impact to CVP/SWP water supply deliveries is not considered to be cumulatively considerable. Year to year changes in hydrology affect export allocations on the order of millions of AFY (allocations can vary from 100 percent to 0 percent of contracted amounts in the worst case), and the minor changes associated with the project (a reduction of 0.2 percent) are not expected to result in a cumulative considerable change in deliveries to CVP or SWP contractors.

With implementation of Mitigation Measure HYD-4, the cumulative impacts of the discharge reduction are expected to be less than significant).

HYD-4: Coordinate Operations with Relevant Resource Agencies: To minimize potential thermal impacts to the Sacramento River downstream of Lake Shasta during critically dry years due to losses of cold water storage from reduced treated wastewater discharges, Regional San shall work with the Bureau of Reclamation and other relevant resource agencies to make appropriate operational changes in recycled water use and timing of discharge reductions in the spring months when the cold water pool in Shasta is critical. In critically dry years when storage in Lake Shasta falls below 2,400,000 AF in April, Regional San will coordinate with Central Valley Operations staff to reduce deliveries of recycled water to farmers in April and May if needed to avoid thermal impacts to the Sacramento River below Lake Shasta, as determined by the Sacramento River Temperature Model being utilized by Reclamation in the given year.

Table 1 List of Cumulative Projects from South Sacramento County Agriculture and Habitat Lands Recycled Water Program EIR (RMC, 2015b)

	Project Name	Estimated Schedule/Status	Project Description	Location	Potential to Combine Impacts?
	Regional San Capital Improvements Plan				
1	EchoWater Program	Approved and under construction	Upgrades to the existing 480-acre SRWTP to comply with the adopted NPDES requirements. The project consists of preliminary and primary treatment facilities, secondary treatment facilities, tertiary treatment and disinfection facilities, auxiliary facilities/systems, odor control, and site improvements.	Within SRWTP	Y
2	Digester Rehabilitation	Construction 2012 – 2018	Rehabilitation of digesters 6 and 7 at SRWTP.	Within SRWTP	Y
3	SPA Recycled Water Project	EIR Certified, approved and under construction	Construct pipeline from SRWTP to Sacramento Power Authority Co-Gen Facility.	Within SRWTP	Y
	Sacramento County				
4	Capital Southeast Connector	Program EIR completed in January 2012	The 35-mile parkway connects at I-5 and Hood Franklin Road in Elk Grove, and extends northeast to Highway 50 and Silva Valley Parkway near Folsom.	Hood Franklin Road and Franklin Boulevard	Y
5	Wilton Rancheria Casino	Draft EIS in preparation	Three alternatives including casino and hotel; casino and no hotel; and retail.	Twin Cities Road at Highway 99	N
	City of Elk Grove				
6	Capital Reserve Project	Construction anticipated to begin in late 2015 or early 2016	Construction of 84 single family residences and commercial uses on 16.7 acres.	Near Highway 99 and Elk Grove Boulevard	Y
7	Civic Center Aquatic Project	EIR Finalized in August 2014	Competition/training swim facility, ancillary uses, parkland, and parking on a 30-acre site.	Civic Center Drive and Big Horn Boulevard	Y
8	Sheldon Park Estates	Construction 2015 - 2018	Rezoning and subdivision of 113 acres into 45 single family lots, open space, and multi-use trail easement.	Sheldon Road and Waterman Road	N
9	Fieldstone North	Subsequent mitigated negative declaration (MND) adopted by City in January 2014. Revised subdivision map adopted and determined exempt from CEQA in May 2014.	Entitlements for a General Plan Amendment, Specific Plan Amendment, Rezone, Large-Lot Tentative Subdivision Map, and Small-Lot Tentative Subdivision Map. The entitlements would allow for the development of 391 residential units on 107.1 acres.	Bradshaw Road and Grant Line Road	N

	Project Name	Estimated Schedule/Status	Project Description	Location	Potential to Combine Impacts?
10	Silverado Village	Elk Grove approved the project in July 2014	651 single family units, 125 senior multifamily units, and parks, trails, and paseos, open space, on 230 acres.	Bond Road and Waterman Road	N
11	Moore Sheldon Center	Subsequent EIR finalized in December 2013 Construction complete; opened April 2016.	Approximately 27,500 square feet of commercial land uses on 4.46 acres.	Near Sheldon Road and East Stockton Boulevard	N
12	Southeast Policy Area Strategic Plan Project	Community Plan adopted in July 2014 EIR finalized in June 2014	A Community Plan and Special Planning Area for an approximately 1,200-acre area. The project would allow for the development of approximately 7.8 million square feet of employment-generating uses; 4,790 residential units in various densities; and acreage for schools, parks, and infrastructure, such as road right-of-way and storm drainage facilities.	Bruceville Road, Kammerer Road, Poppy Ridge Road, West Stockton Boulevard	Y
13	Dignity Health Elk Grove Medical Campus	Construction to begin in 2017 with a 20 year build out	Construction of a six-story, 460,000-square-foot, 330-bed hospital; a three-story, 65,000-square-foot medical office building, and a five-level, 170,000-square-foot parking structure. Construction would be constructed in four phases.	Wymark Drive and Elk Grove Boulevard	Y
14	Storm Drain Master Plan		Various watershed projects for storm drainage and flood control, aquatic resources and water quality protection.	City-wide	Y
	Wastewater Change Petitions				
15	City of Colusa	Project approved by City Council in March 2015 Wastewater change petition filed with SWRCB in June 2015	The City of Colusa has filed a wastewater change petition, seeking to reduce the discharge of treated wastewater to Powell Slough. The City proposes to divert approximately 0.41 million gallons per day of wastewater discharge for seasonal irrigation on up to 84 acres of land (within a 185-acre gross). Discharge would be reduced by 456 AFY, which corresponds to an average of 0.63 cfs.	Immediately east and south of Colusa wastewater treatment plant (WWTP), current discharge is to unnamed tributary of Powell Slough	Y
16	City of Woodland	Initial Study/MND (IS/MND) completed in February 2015 Wastewater change petition filed in May 2015 Construction anticipated to begin in 2015	The City of Woodland has filed a wastewater change petition, seeking to reduce the discharge of treated wastewater from its Water Pollution Control Facility (WPCF) to the Tule Canal tributary to the Sacramento River. With the petition, the City requests to deliver up to 0.5 million gallons per day (mgd) of its tertiary treated wastewater effluent to industrial use and landscape irrigation. Discharge would be reduced by 0.77 cfs, which would reduce annual discharge by 560 AFY.	Woodland Biomass Facility located at 1786 E Kentucky Avenue in Woodland and two parks located in the City.	Y

	Project Name	Estimated Schedule/Status	Project Description	Location	Potential to Combine Impacts?
17	City of Biggs	EIR finalized in December 2013 Wastewater Change Petition approved by SWRCB in June 2014	The City of Biggs Wastewater Treatment Plant filed a wastewater change petition, seeking to eliminate discharge of effluent to Lateral K, which drains to Butte Creek, thence the Sacramento River. The treated effluent would be used to irrigate 120 to 140 acres located to the south or west of the wastewater treatment plant. Discharge would be reduced by 0.46 cfs, which would reduce annual discharge by 333 AFY.	WWTP is located at 2951 West Biggs Gridley Road. West Option is immediate west of WWTP; South Option is immediately south of WWTP.	Y
	Freeport Regional Water Authority				
18	Intake Facility and Pipeline and Folsom South Canal Connection	Operational	185 mgd water intake facility and pumping plant on the Sacramento River, and 17 miles of underground water pipelines within Sacramento County. Facilities provide Sacramento County Water Agency (SCWA) and East Bay Municipal Utility District (EBMUD) with 85 mgd and 100 mgd, respectively. EBMUD uses up to 100 mgd during dry years only as a supplemental water source.	Sacramento and San Joaquin Counties	N
	Bureau of Reclamation				
19	Long-Term Water Transfers	2015 - 2024	Transfers of Central Valley Project (CVP) and non CVP water or transfers from north of the Delta to CVP contractors south of the Delta that require the use of CVP and State Water Project (SWP) facilities. Water would be made available for transfer through groundwater substitution, cropland idling, crop shifting, reservoir release, and conservation.	Alameda, Butte, Colusa, Contra Costa, Fresno, Glenn, Kings, Merced, Placer, Sacramento, San Benito, San Joaquin, Santa Clara, Shasta, Solano, Stanislaus, Sutter, Tehama, Yolo, and Yuba Counties	Y
20	Coordinated Long-Term Operation of the Central Valley Project and State Water Project	Final EIS published on November 23, 2015	Reclamation proposes to continue the operation of the Central Valley Project in coordination with the State Water Project by implementing the associated 2008 U.S. Fish and Wildlife Service Biological Opinion and the 2009 National Marine Fisheries Service Biological Opinion, including the Reasonable and Prudent Alternatives.	Statewide	Y
21	California WaterFix (Bay Delta Conservation Plan [BDCP], Alternative 4A)	Recirculated Draft EIR/EIS published on July 10, 2015; Final EIR/EIS in preparation	In cooperation with the California Department of Water Resources, Reclamation is considering a project to provide more reliable delivery of water exports from the Delta through the State Water Project and the Central Valley Project. Alternative 4A, California WaterFix has been identified as the preferred alternative but all of the BDCP alternatives will be considered by decision makers in determining whether to approve the project.	Intakes would be relocated from south Delta to a north Delta location downstream of the SRWTP	Y

Other Future Project and Water Management Actions

Additional future project and water management actions beyond what was analyzed in the CEQA cumulative analysis are presented below. The list provided in the Technical Reference Document in Section 10.2 was reviewed and considered in this evaluation of uncertainty (CWC, 2016).

Changes Related to Water Storage

The proposed Program is not dependent on other water storage projects for water supply. FERC relicensing or other operational changes at facilities affecting Shasta operations could have some impacts on the frequency of HYD-4 implementation conditions (tied to cold water pool, see explanation in CEQA cumulative impacts description above), though none are currently identified or anticipated. Increases in the frequency of HYD-4 conditions would not have significant impacts to benefits over the life of the project. HYD-4 conditions are expected to occur in approximately 5 percent of years under 2030 climate conditions and 13 percent under 2070 climate conditions. Even if other water storage changes doubled the frequency under which HYD-4 would be in effect, about 25 percent of the years would be expected to be impacted under 2070 climate conditions. Additionally, HYD-4 would affect recycled water deliveries in April and May, allowing for remaining irrigating season months to receive recycled water. Operations of recycled water deliveries could be adjusted to allow additional deliveries made in other months to make up for reduced deliveries under HYD-4 (subject to irrigation demand, system conveyance capacities, and/or ability to increase wintertime recharge). The proposed Program infrastructure (RMC 2015b) and preliminary operations plan (**Benefit Calculation, Monetization, and Resiliency Tab A.**1) already provide for some flexibility to implement these potential operational changes.

Changes Related to Flood Management

There are no anticipated affects related to flood management, except for the ability to supply recycled water in the wintertime if the area is flooded.

Changes Related to Ecosystem Conditions and Management

As discussed in the Ecological Plan (TFT, 2017) attached under Physical Public Benefits **Tab A.2** and the Preliminary Operations Plan attached under **Benefit Calculation, Monetization, and Resiliency Tab A.1**, the proposed Program provides benefits to neighboring and otherwise-related ecosystem restoration and management activities. Changes related to those activities would not be expected to negatively impact Program benefits. Program operations may be adjusted to enhance benefits in different locations within the region if other activities promote changes to targeted benefits (for example, if another activity improves ecological conditions along one riparian corridor, Program activities may be targeted to other areas of greater need).

Changes Related to Groundwater and Other Water Management

The groundwater modeling approach used for with- and without- project quantification of benefits includes sustainable yield assumptions based on information from the Sacramento Water Forum and likely to be included in SGMA implementation in the subbasin in the future (RMC, 2017). Water conservation in the Sacramento region could reduce indoor water consumption, which could reduce wastewater flows to the Regional Wastewater Treatment Plant. As discussed in 10.1 above, Regional San's total wastewater flows (132,000 AFY) are well in excess of the recycled water supply of 50,000 AFY, so water conservation effects would have to be extreme (on the order of 50% reductions in indoor water use) in order to approach any effect on recycled water supply for the Program. Water conservation mandates are not typically applicable to recycled water use either. However, future agricultural water conservation changes (not currently anticipated) could affect irrigation deliveries (less

likely with recycled water use). If agricultural water conservation changes, including those for recycled water use, were to occur, then benefits could be slightly reduced, commensurate with reduced in-lieu recharge. More likely, the farmers would reduce their own pumping of groundwater first, rather than take reduced recycled water deliveries. These reduced benefits would not be expected to be substantial, and could be mitigated by increases in deliveries and changes to operations for wintertime recharge.

Changes Related to Delta Operations and Management

Changes related to California WaterFix are discussed in the EIR section shown above. California EcoRestore and the proposed Program would complement the ecological benefits of one another, as outlined in the Ecosystem Conditions and Management discussion above. Other changes to Delta operations related to future salinity-related policies or decisions could affect how the proposed Program operates relative to fishery-related cold water pool management in critical dry years, in coordination with operators of the CVP and SWP. It is difficult to foresee what specific operational changes might be needed to adapt to future salinity impacts in the Delta, but the proposed Program's benefits with respect to salinity in the Cosumnes and Mokelumne River and recharging the groundwater basin should have profound positive effects on the threat of salt water intrusion impacts to the subbasin and adjoining basins.

10.3 Other Sources of Uncertainty

In addition to uncertainties with climate change, other sources of uncertainties that cannot be adequately quantified at this time will be taken into account in the Program operations and implementation in the future. Such uncertainties are related to the actual water accounting framework under the Program banking operations, the Program operations in the context of the SGMA implementation, wintertime irrigation regulatory requirements, and the Program's petition for change related to recycled water and the corresponding reduction in Regional San's discharge. If future conditions differ from those anticipated under the current understanding, Regional San will continue to use resources to improve understanding of uncertainties and adapt to changing conditions. One of the important aspects of the Program is that the Program operations will be closely monitored and adaptively managed to maintain public benefits claimed.

The groundwater volume actually stored and extracted under the Program will vary on an annual basis during banking operations. Benefits from the Program and potential impacts to other areas would vary depending on the method, location, magnitude, and use of potential extraction of banked water. Regional San is having ongoing discussions of the proposed project banking and recharge operations with the Sacramento Central Groundwater Authority (SCGA), which includes a broad consortium of agencies in the region. The proposed project extractions will be further refined in coordination with the SCGA and its member agencies as a water accounting framework and groundwater bank is developed. Based on the ongoing discussions, it is anticipated that the agencies in the region would have the capability to extract up to 30 percent of the banked water during extraction years. Regional San will continue discussions for refining a water accounting framework and banking partnerships that will be consistent with the future conjunctive use operations in the region.

SGMA efforts in the region are at early stages of development and the framework for SGMA has not been formally established at this time. The Program is located within the South American subbasin of the Sacramento Valley groundwater basin, which is classified as a high priority basin by DWR. SCGA formed as a GSA in July 2016 with a 16-member board that represents all groundwater users and stakeholders in the South American subbasin. Regional San has been a board member since SCGA's 2006 inception and will work with SCGA and other relevant agency or agencies to operate the Program in a manner that will help with implementation of SGMA. The Program will support the SGMA efforts and help manage the basin sustainably as the Program directly benefits the groundwater of the South American subbasin with increase in groundwater storage, levels, and streamflow.

The Program, as currently envisioned, includes wintertime passive recharge of approximately 17,000 AFY though wintertime irrigation, a potential wildlife-friendly active recharge component, or a combination of the two. For groundwater modeling purposes, it was assumed that wintertime recharge would be evenly distributed across the recycled water service area as wintertime irrigation and passive recharge. A more targeted distribution and recharge approach may improve on public benefits claimed under ecosystem and recreation benefits, as mentioned in Sections 2.0.1 – Public Benefits and 2.1.1 – Operational Drought Resiliency of the Preliminary Operations Plan (found attached under **Benefit Calculation, Monetization, and Resiliency Tab A.2**). Uncertainty exists with respect to the details within which wintertime recharge approach will be implemented (modeling assumed even distribution rather than targeted recharge) and landowner participation in a wildlife-friendly active recharge component, neither of which should substantially impact expected Program benefits other than to enhance them sooner and more widespread as implementation occurs.

More substantive uncertainty exists regarding regulatory guidance on wintertime irrigation and active recharge with recycled water. Wintertime irrigation for groundwater recharge is an emerging approach to improve groundwater level conditions (RMC, 2015a). Recycled water groundwater recharge projects have been prevalent in Southern California for decades, but represent an emerging approach in other parts of the State to improving groundwater level conditions, as reflected in the State Water Resources Control Board (SWRCB) Resolution 2010-0003 issued in response to the recent drought in California, and other recent updates to recycled water-related statutes and regulations[1]. The proposed Program is at the leading edge of both approaches, and as such will necessitate coordination with regulators, policy-makers, and the legislature to maximize the expected benefit to cost ratio of the Program while maintaining or improving public and environmental health. Planned operational flexibility of the Program across the service area (such as targeting deliveries to specific recharge areas) accommodates a variety of recycled water delivery and use approaches. The Program can also be amended to accommodate other yet-to-be-determined regulatory requirements, but likely at greater costs.

Implementation of the proposed Program requires that Regional San obtain approval of a Petition for Change for Owners of Waste Water Treatment Plants (Petition for Change) from the SWRCB, Division of Water Rights pursuant to Section 1211 of the Water Code before making a change in the point of discharge, place of use, or purpose of use of treated water. The process for the Petition for Change is currently underway, and is anticipated to be completed by the end of 2017.

Approval of the Petition for Change would result in the issuance of an order from the SWRCB confirming Regional San's right to use the recycled water as set forth in the Petition, which would enable a change in the point of discharge from the Sacramento River to new places of use – farmlands, wetlands, and/or potential recharge areas, and would also enable a change in the purpose of use of the treated water. In reviewing and approving Petitions for Change, the Division of Water Rights (Division) must be able to find that the proposed change would not injure other legal users of water, would not unreasonably affect fish and wildlife, and would not be contrary to the public interest. This petition process also allows other parties to protest the application and raise concerns regarding any injury to their legal uses of the water involved, or environmental or public interest concerns. The SWRCB would issue an order approving the petition if the change of the discharge did not result in injury to legal users of the water involved or result in an unreasonable effect on fish and wildlife.

At this time, there are several protests pending to Regional San's wastewater change petition (WW-0092) for the Project, and Regional San is in the midst of protest resolution discussions with the protestants. Regional San is hopeful that it will be able to resolve the pending protests without the need for a hearing before the SWRCB. Regional San will report back to the SWRCB staff by September 15, 2017 regarding the status of the protest resolution efforts.

Under the Program, Regional San would maintain its existing discharge location at the Sacramento River, and would continue to maintain an NPDES permit for river discharge, but the proposed Program would reduce the volume of recycled water discharged to the Sacramento River at certain times of the year, with the new point of discharge being agricultural and urban irrigation customers, and wetlands, in addition to ongoing river discharge. The South County Ag Program has significant benefits such as, recovering groundwater levels, restoring habitats, enhancing groundwater & surface water connectivity, improving water quality and ensuring water supply flexibility for Sacramento County and the Delta. The

[1] Recycled water regulations are an actively evolving field in California law and policy. The SWRCB offers resources on recent updates to statutes and regulations online at: http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Lawbook.shtml

Program would add greater flexibility to the management of the local groundwater and surface water resources conjunctively and contributes to the improved management of water resources at the regional and state-wide level.

Although the Program would divert up to 50,000 AFY of Regional San's current discharge to agricultural lands in southern Sacramento County, the impacts to Delta outflow are minimal. To put these values into perspective 50,000 AFY is less than 0.8 percent of the Dry and Critically Dry year type (D1641 40-30-30) average Delta outflow and is less than 1.3 percent of the Dry and Critically Dry year type (D1641 40-30-30) average Delta export relative to the Without Program condition. As the Program is implemented and the groundwater and surface water connectivity increases, any impacts to Delta outflows become mitigated. Essentially, as groundwater conditions improve, increases in streamflows occur and sufficient water is banked to support extractions and associated surface water diversions are reduced. After ten years of operations the impact of the Program is reduced by more than 50 percent (from 50,000 AFY down to 24,980 AFY). After twenty years of operations the impact of the Program is reduced by more than 80 percent (down to 7,970 AFY) and through the remaining life of the Program the risk of impacts to Delta outflow and Delta exporters is reduced to negligible levels.

10.4 Drought Analysis

Groundwater modeling analysis was conducted to simulate the 1970-2011 hydrology that includes an extended drought period from 1987-1992 with consecutive dry or critically dry years in the Sacramento Valley. The hydrology for precipitation, evapotranspiration, and streamflows were modified to incorporate the 2070 climate change conditions for the entire simulation period including the drought period. Based on the classification of the 2070 climate change hydrology, this period was also defined as consecutive dry or critically dry year under the 2070 climate change conditions based on the CWC WSIP 2070 models[1]. For the five-year drought assessment, the period 1988-1992 was used to quantify the amount of water stored by the Program that could be used for public benefits at the beginning and end of the five-year drought and to assess the ability of the Program to perform during droughts.

Groundwater modeling simulates the 1970-2011 hydrology twice, including the five-year drought period of 1988-1992 considered for the drought assessment (RMC, 2017). For this assessment, the Program benefits prior to the drought were quantified based on the second drought period to allow the Program to achieve its full benefits and the groundwater system to reach near-equilibrium. The five-year drought used for this analysis corresponds to simulation years 61 through 65.

Figure 1 presents the benefits with respect to the increase in groundwater storage with the Program operations under the 2070 climate conditions over the 84-year simulation, highlighting the five-year drought period used for this assessment. Figure 2 looks more closely at the changes for years prior to, during, and after the drought period, with the extraction years, further illustrating how the storage changes in response to the Program recharge. While the changes vary annually in response to the extraction and storage increases more slowly or slightly declines during and immediately after the extraction years. The Program in-lieu and wintertime recharge of 50,000 AFY results in an overall storage increase even during the five-year drought. In years without the extraction of the banked water, the storage increases at a higher rate both during and after the drought period.

Table 1 summarizes the potential benefits from the Program both for the groundwater storage and streamflows at the beginning and the end of the five-year drought period in comparison to the entire simulation for the 2070 climate conditions. Consistent with the results presented in Figures 1 and 2, the Program continues to achieve benefits both during and after the five-year drought, with increases in storage and streamflow. During the five-year drought, even with the Program extractions occurring, the storage would continue to increase. With respect to streamflow, the benefits are maintained, although slightly smaller than those achieved before the drought and during the entire simulation period. Overall, the modeling results presented in Figures 1, 2, and Table 1 under the 2070 climate conditions demonstrate the Program benefits to groundwater storage and streamflow, and the Program's ability to achieve and maintain benefits across a wide range of potential climate change, including the five-year drought period.

[1] California Water Commission. 2016. Water Storage Investment Program Climate Change and Sea Level Rise Data and Model Products Update. California Water Commission.
(https://cwc.ca.gov/Documents/2017/WSIP/WSIP_Data_and_Model_Product_Description_2-22-17.pdf

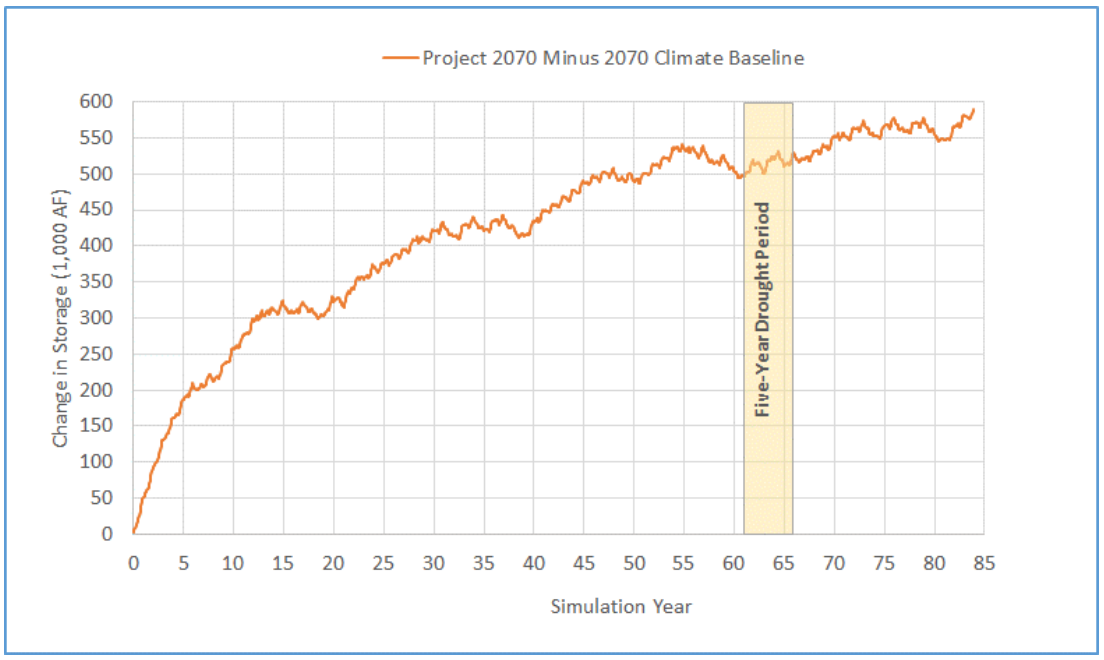

Figure 1: Change in Groundwater Volume, Project 2070 Compared to 2070 Climate Baseline

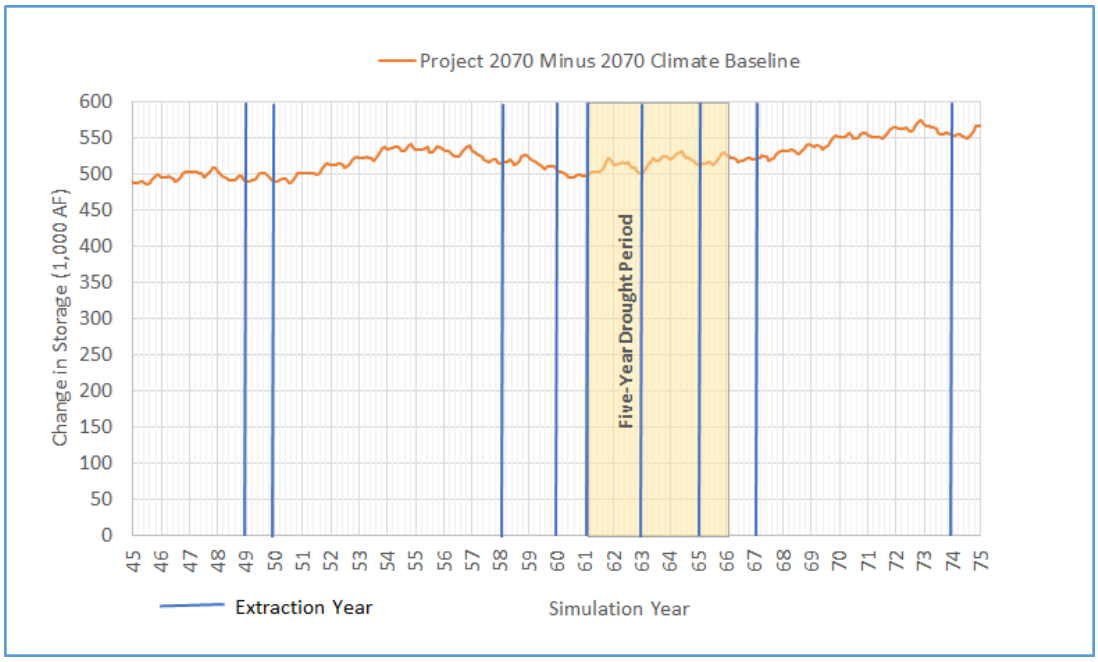

Figure 2: Change in Groundwater Volume with Five-Year Drought Period, Project 2070 Compared to 2070 Climate Baseline

Table 1: Groundwater Storage and Streamflow Benefits with Five-Year Drought Period – Project 2070 Scenario Compared to 2070 Climate Baseline

	Prior to Five-Year Drought [1]	After Five-Year Drought [2]	Entire Simulation [3]
Groundwater Storage (AF)	497,000	511,000	590,000
Increased Streamflow (AFY)	16,900	16,600	17,200

Footnote:

(1) This represents the benefits at the end of simulation year 60, prior to the five-year drought relative to the climate change baseline conditions.

(2) This represents the benefits at the end of the five-year drought at simulation year 66 relative to the climate change baseline conditions.

(3) This represents the benefits for the entire 84-year simulation period relative to the climate change baseline conditions.

References

CH2M. 2017. *South County Ag Program WSIP Application Surface Water Operations and Temperature Modeling*. August. GRANTS Benefit Calculation, Monetization, and Resiliency tab, A.1 Project Condition. File; "Regional San_CALSIM_HEC5Q_ModelingTM_A.1ProjectConditions _SecBCMR.pdf"

California Water Commission (CWC). 2016. *Water Storage Investment Program Technical Reference.* November.

RMC Water and Environment. 2014. *Sacramento Regional County Sanitation District South County Recycled Water Feasibility Study.* May. https://www.regionalsan.com/general-information/south-county-ag-feasibility-study

RMC Water and Environment. 2015a. *Creating an Opportunity: Groundwater Recharge through Winter Flooding of Agricultural Land in the San Joaquin Valley*. October. Available online: http://waterfdn.org/wp-content/uploads/2015/09/Creating%20an%20Opportunity%20On%20Farm%20Recharge%20Summary%20Report%20(00306326xA1C15).pdf. Accessed August 8, 2017.

RMC Water and Environment. 2015b. *South Sacramento County Agricultural & Habitat Lands Recycled Water Program Facilities Plan, Draft.* August. Updated June 2017. GRANTS Eligibility and General Project Information tab, A.4 Project Description Support. File: "Regional San_Facilities Plan_Vol1_Report_A.4_Project Description Support_SecEGPI.pdf"

RMC Water and Environment. 2016. *Sacramento Regional County Sanitation District's South Sacramento County Agriculture and Habitat Lands Recycled Water Program Draft Environmental Impact Report (SCH#: 2015022067).* July. https://www.regionalsan.com/post/south-county-ag-final-environmental-impact-report

RMC Water and Environment. 2017. *Integrated Groundwater and Surface Water Modeling Results Technical Memorandum*. August. GRANTS Benefit Calculation, Monetization, and Resiliency tab, A.1 Project Condition. File; "Regional San_SacIWRMModelingTM_A.1 Project Conditions_SecBCMR.pdf"

The Freshwater Trust (TFT). 2017. *Conceptual Ecological Plan & Ecosystem Benefits*. August. GRANTS Physical Public Benefits tab, A.1 Ecosystem Benefits. File: "Region San EcoPlan_A.1 EcoBenefits_SecPPB .pdf"